We claim:

1. A method for manufacturing of a photo mask blank, in particular of a binary photo mask blank, a phase shifting photo mask blank or an extreme ultra violet photo mask blank, comprising the steps of:

providing a substrate and a target in a vacuum chamber,

providing a first particle beam,

sputtering said target by irradiating with said first particle beam,

depositing at least a first layer of a first material on said substrate by said sputtering of said target.

2. The method of claim 1, wherein

said first particle beam is directed onto said target and sputtered particles emerge from said target in direction to said substrate.

3. The method of claim 1, wherein

at least a second layer of a second material is deposited on said photo mask blank by sputtering of said target.

4. The method of claim 1, wherein

said target defines a target normal line and said first particle beam hits said target under an angle to said target normal line.

5. The method of claim 1, wherein

said substrate defines a substrate normal line and sputtered particles from said target hit said photo mask blank under an angle to said substrate normal line.

6. The method of claim 1 wherein the rate of depositing of said first layer is between 0.01 and 5 nm/sec.

7. The method of claim 1, wherein

said photo mask blank is irradiated by a second particle beam.

8. The method of claim 7, wherein

said substrate defines a substrate normal line and said second particle beam hits said photo mask blank under an angle to said substrate normal line.

9. The method of claim 7, wherein

at least one of said first and second particle beam comprises an ion beam.

10. The method of claim 7, wherein

at least one of said first and second particle beam comprises an ion beam, which is accelerated and focused by an electromagnetic field.

11. The method of claim 7 wherein said first and second particle beams are separately controlled for independently depositing layers by said first particle beam and treating at least one of said substrate and said layers by said second particle beam.

12. The method of claim 7, wherein

said first and second particle beams comprise different particles.

13. The method of claim 7, wherein

said first and second particle beams have different particle energies.

14. The method of claim 7, wherein

a surface of said substrate is conditioned by irradiating with said second particle beam.

15. The method of claim 7, wherein

a surface of said substrate is cleaned from impurities by irradiating with said second particle beam before said deposition of said first layer.

16. The method of claim 15, wherein

at least one reactive gas is provided in said vacuum chamber at a predetermined pressure and said cleaning is enhanced by said at least one reactive gas.

17. The method of claim 16, wherein

said at least one reactive gas comprises oxygen.

18. The method of claim 7, wherein

at least one of the layers is doped by irradiating with said second particle beam.

19. The method of claim 18, wherein

a plurality of layers is deposited on said photo mask blank and different layers are differently doped.

20. The method of claim 18, wherein

at least one of the following parameters:

optical density,

etch time,

adhesion and

reflectance of at least one of the layers

is controlled by said doping.

21. The method of claim 7, wherein

a surface of at least one of the layers is flattened by irradiating with said second particle beam after the deposition of said at least one layer.

22. The method of claim 7 wherein further layers are deposited on said photo mask blank and interface roughness between said layers is reduced by irradiating with said second particle beam.

23. The method of claim 7 wherein reflectance of a surface of a reflecting layer is increased by irradiating with said second particle beam.

24. The method of claim 1 wherein said first particle beam comprises an ion beam.

25. The method of claim 24 wherein said ion beam is a Xenon ion beam.

26. The method of claim 25 wherein reflectance of a surface of a reflecting layer is increased by sputtering the target by irradiating with said Xenon ion beam.

27. A method for manufacturing of a photo mask blank, in particular of a binary photo mask blank, a phase shifting photo mask blank or an extreme ultra violet photo mask blank, comprising the steps of:

providing a substrate and a sputter target in a vacuum chamber,

providing a deposition particle source and an assist particle source,

providing a first and second particle beam by means of said deposition and assist particle source, respectively,

sputtering said target by irradiating with said first particle beam, wherein said first particle beam is directed from said deposition particle source onto said target and sputtered particles emerge from said target in direction to said substrate,

depositing (growing) at least a first layer of a first material on said substrate by said sputtering of said target

depositing (growing) at least a second layer of a second material on said first layer by sputtering of said target,

irradiating said photo mask blank with said second particle beam for treating said substrate or at least one of said layers. .

28. A method for manufacturing of a photo mask blank, in particular of a binary photo mask blank, a phase shifting photo mask blank or an extreme ultra violet photo mask blank, comprising the steps of:

providing a substrate in a vacuum chamber,

growing a layer of a first material on said substrate, wherein

said step of growing said layer is performed by ion beam deposition (IBD).

29. The photo mask blank, in particular being a binary photo mask blank, an extreme ultra violet photo mask blank or a phase shifting photo mask blank, obtainable by the method of claim 1.

30. A mask blank, in particular a binary photo mask blank, a phase shifting photo mask blank or an extreme ultra violet photo mask blank, comprising

a substrate and

one or more layers being deposited on said substrate by ion beam deposition.

31. The mask blank of claim 30, wherein

said mask blank is characterized by being treated by irradiating with a second particle beam.

32. The mask blank of claim 30, wherein

at least one of said layers has a grain size of 0 nm to 10 nm.

33. The mask blank of claim 30, wherein

at least one of said layers has a surface roughness of lower than 5 nm rms.

34. The mask blank of claim 30, further comprising

a light reducing (or absorber) layer.

35. The mask blank of claim 30, further comprising

an anti-reflective layer.

36. A photo mask manufactured (by a lithography method) of the mask blank of claim 30.

37. An apparatus for manufacturing of a mask blank, in particular of a binary photo mask blank, a phase shifting photo mask blank or an extreme ultra violet photo mask blank, comprising:

a vacuum chamber suitable for evacuation and in which a substrate and a target are disposable,

a deposition particle source for providing a first particle beam which is directable towards said target for sputtering of said target and depositing at least a first layer on said substrate and

an assist particle source for providing a second particle beam which is directable towards said substrate for treating of said substrate.

38. The apparatus of claim 37, wherein

at least one of said deposition particle source and said assist particle source provide an ion beam.

39.The apparatus of claim 37, wherein

said deposition particle source provides a first ion beam and said apparatus comprises means for providing an electromagnetic field for accelerating and focusing said first ion beam on its way to said target.

40.The apparatus of claim 37, wherein

said deposition and assist particle source are separately controllable.

41.The apparatus of claim 37, wherein

said deposition particle source and said assist particle source are suitable to provide beams of at least one of different directions, different particles, and different particle energies.

42. The photo mask blank, in particular being a binary photo mask blank, an extreme ultra violet photo mask blank or a phase shifting photo mask blank, obtainable by the method of claim 27.

43. The photo mask blank, in particular being a binary photo mask blank, an extreme ultra violet photo mask blank or a phase shifting photo mask blank, obtainable by the method of claim 28.